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RESULTS OF INVESTIGATIO
AT PRIORITY 1 LANDFILL
SITES IN ALBERTA
- FINAL REPORT

ENVIRONMENTAL PROTECTION SERVICES

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RESULTS OF INVESTIGATIONS AT PRIORITY 1 LANDFILL SITES IN ALBERTA - FINAL REPORT

ALBERTA ENVIRONMENT
ENVIRONMENTAL PROTECTION SERVICES
EARTH SCIENCES DIVISION
GROUNDWATER PROTECTION BRANCH

Prepared by:

Walter J. Ceroici, P. Geol.
Hydrogeologist
Groundwater Protection Branch

October 10, 1986

Submitted by:

L.J. McCracken
Head
Groundwater Protection Branch

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ABSTRACT

Alberta Environment initiated a study in 1981 to investigate waste disposal sites in the Province. In Phase I and II of the study an inventory of all active and abandoned land disposal sites was compiled. An attempt was made to rate each site according to its threat to public health and/or the environment. Of 1152 active and inactive disposal sites identified, eighteen were assessed as potentially threatening. In Phase III, detailed hydrogeological investigations were conducted by Alberta Environment at seventeen of the eighteen sites. At twelve of the sites groundwater contamination was found to be insignificant (i.e. no threat to the environment) and remedial action or further monitoring was not necessary. Five of the sites were found to require additional monitoring to further assess suspected groundwater contamination and/or investigate anomalous data.

Additional work was conducted by Alberta Environment at the five Class 1 and 2 sites and at the Kinbrook Island site. The work concluded that groundwater contamination did not represent a threat to human health or the environment at any of the sites.

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INTRODUCTION

In 1981, Alberta Enviornment, initiated a study to identify all waste disposal sites in the Province and to assess their impact on public health and the environment. A phased approach was adopted to facilitate the review of study progress.

The first phase involved compiling an inventory of all waste disposal facilities and developing a ranking system in order to rate the sites according to their impact on the environment. A total of 1152 active and abandoned waste sites were identified (MacLaren Plansearch Lavalin, 1982). Of these sites, 167 were designated Class 1, or sites requiring further investigation.

The second phase of the study, initiated in 1983, reviewed the 167 Class 1 sites and qualitatively assessed their impact on the environment (Associated Engineering Services Ltd., 1985). Assessments involved a literature review, interviews with local officials and a visit to each site. Of the 167 Class 1 sites, 18 were judged to be Priority 1, or sites requiring immediate attention because they were considered to present an immediate or potential threat to public health or the environment.

In Phase III of the study, the Groundwater Protection Branch of Alberta Enviornment, conducted detailed hydrogeologic investigations and installed a groundwater monitoring system at each of the eighteen landfill sites (Ceroici, 1986). To express the level of contamination at the eighteen sites the following rating was developed:

CLASS 1. Sites for which groundwater contamination has been detected. Groundwater down-gradient from the disposal facility is of poorer quality than background water, with the concentration of several consituents exceeding recommended upper limits for Canadian Drinking Water. Additional monitoring is required to determine the level, extent and impact of contamination.

CLASS 2. Sites for which groundwater contamination is suspected. Additional monitoring is required to confirm anomalous data or to obtain additional information.

CLASS 3. Insignificant or no groundwater contamination detected. Groundwater down-gradient from the disposal facility is chemically similar to background water. No further action required.

The results of the Phase III investigation are summarized in Table 1. Of the eighteen sites, twelve were rated as class 3, no threat to public health or the environment - no further action required. Four of the sites were rated as class 1 or 2, requiring additional monitoring due to suspected groundwater contamination or uncertainties about analytical data. The Kinbrook Island site could not be investigated in the summer and fall of 1985 since it was inundated by Lake Newell.

This report presents the results of additional monitoring at Class 1 and 2 sites, and of the investigation at the Kinbrook Island site.

2. STUDY DETAILS

Additional groundwater monitoring at the sites consisted of collecting replicate samples for chemical analysis and installing additional instrumentation at the Glenwood and Edson sites. For details of sampling and preservation techniques the reader is referred to the Phase III report.

An investigation was completed at the Kinbrook Island site in February, 1986. Results of the investigation are contained in Appendix A. The results of additional monitoring at Class 1 and 2 sites is contained in Appendix B.

TABLE 1. SUMMARY OF PHASE III INVESTIGATIONS

	LANDFILL	CLASS	RECOMMENDATIONS
1.	Animal Diseases Research Institute (NE 12-09-23-W4)	3	No action required
2.	Czar (SE 20-40-06-W4)	3	No action required
3.	Donnelly (SE 12-78-21-W5)	3	No action required
4.	Edson (NE 09-53-17-W5)	2	Additional drilling required south of disposal site in muskeg area
5.	Ferintosh (NW 03-44-21-W4)	3	No action required
6.	Gleichen (SW 24-22-23-W4)	3	No action required
7.	Glenwood (SW 01-05-27-W4)	2	Additional groundwater sampling required
8.	Hartell (NE 09-19-02-W5)	3	No action required
9.	High Prairie (SE 26-74-17-W5)	1	Collect samples from West Prairie River and resample W364
10.	Kinbrook Island (NE 19-17-14-W4)	N/A	Drilling program to be conducted in early 1986
11.	Linden (SE 20-30-25-W4)	3	No action required
12.	Manola (NE 16-59-2-W5)	3	No action required
13.	Minburn (SW 14-50-10-W4)	2	Resample P309 to confirm anomalously high organic load
14.	New Sarepta (NW 34-49-22-W4)	3	No action required
15.	Paradise Valley (NW 7-47-2-W4)	3	No action required
16.	Red Deer (Montfort School) (NE 20-38-27-W4)	3	No action required
17.	Red Deer Motors (SE 8-38-27-W4)	3	No action required
18.	Red Deer (Sewage Treatment Plant) (NW 34 -38-27-W4)	1	Collect additional samples of the river for chemical analysis. Obtain accurate hydraulic conductivity data for geologic materials between the landfill and the river.

From: Ceroici (1986)

3. SUMMARY AND CONCLUSIONS

Shallow groundwater in the vicinity of the Kinbrook Island site was found to be contaminated. However; the level of contamination is insignificant and has not polluted water in Lake Newell. In light of these findings the site has been down-graded to a class 3, requiring no further action.

The results of additional sampling at the four Class 1 and 2 sites indicate that groundwater contamination around the sites does not pose a threat to human health or the environment. A reclassification is presented in Table 2.

TABLE 2. RECLASSIFICATION OF CLASS 1 and 2 SITES

LANDFILL	OLD RATING	NEW RATING	RECOMMENDATIONS
Edson (NE 09-53-17-W5)	2	3	No action required
Glenwood (SW 01-05-27-W4	2	3	No action required
High Prairie (SE 26-74-17-W5)	1	3	No action required
Minburn (SW 14-50-10-W4)	2	3	Site does not meet landfill siting criteria
Red Deer (Sewage Treatment Plant) (NW 34-38-27-W4)	1	3	No action required

4. REFERENCES

Associated Engineering Services Ltd., 1985: Field Investigation of Waste Disposal Sites. Report prepared for Alberta Environment.

Health and Welfare Canada, 1978: Guidelines for Canadian Drinking Water Quality, 1978.

MacLaren Plansearch Lavalin, 1982: Indentification and Verification of Active and Inactive Land Disposal Sites in Alberta. Report prepared for Alberta Environment and Environment Canada.

Ceroici, W.J., 1986: Results of Investigations at Priority 1 Landfill Sites in Alberta. Alberta Environment report.

APPENDIX A

KINBROOK ISLAND REPORT

KINBROOK ISLAND PROVINCIAL PARK LANDFILL

Pt. Sec. 19-17-14-W4

Location

- the site is located in the northeast corner of Kinbrook Island (Figure 1);
- the site is approximately 1.2 ac (0.5 ha) in size;
- the site has been reclaimed;
- the reclaimed site is normally under 0.5 to 1 m of water (Lake Newell) for most of the year.

Field Program

Test Drilling and Monitor Completion

- five test holes were drilled (locations shown in Figure 2 and borehole logs attached);
- four water table wells (WTW) and one piezometer (PIEZ) were installed (completion details in Table 1).

Monitoring

- water levels were recorded on February 11, 1986 (Table 1):
- groundwater and lake samples were collected for chemical analysis on February 11, 1986 (Table 2).

Study Results

Geology

- in the vicinity of the landfill (4741-T), the geologic sequence is comprised of coarse surficial lacustrine sediments (to 1 m) overlying sand and silts (to 4 m) which overlie glacial till deposits (to 6.5 m);
- bedrock strata, comprised of siltstone, shale and sandstone beds, underlie the till;
- soil chemistry analyses for samples obtained from selected test holes are contained in Table 3.

Hydrogeology

- shallow groundwater flow is toward Lake Newell;
- at the time of drilling the depth to water table was approximately 0.5 to 0.75 m below ground surface (see Table 1);

- the shallow groundwater system is hydraulically connected to the lake;

- the hydraulic conductivity of the sandy lacustrine sediments and the underlying sand unit is expected to be in the order of 10^{-4} cm/s.

Groundwater Chemistry

- background groundwater (4743-T) is predominantly a sodium-sulphate type with a total dissolved solids (TDS) concentration greater than 7500 mg/L;

- all inorganic chemical constituents with the exception of chloride exceed the upper limits established by Canadian Drinking Water Standards (CDWS) in groundwater from 4743-T and 4739-T and 4742-T;

- chloride ion concentrations are highest in groundwater from 4739-T and 4742-T, located adjacent to the landfill area;

- groundwater from well 4740-T, which is located between the landfill and the lake, has a relatively low TDS concentration of 1271 mg/L. This suggests that water from Lake Newell may be 'freshening' shallow groundwater in the area.

Lake Newell Water Chemistry

- lake water is the calcium/magnesium - bicarbonate type with a TDS concentration less than 300 mg/L:

- all chemical constituent concentrations are less than the upper limits established by CDWS.

Conclusions

- background shallow groundwater is poor quality;

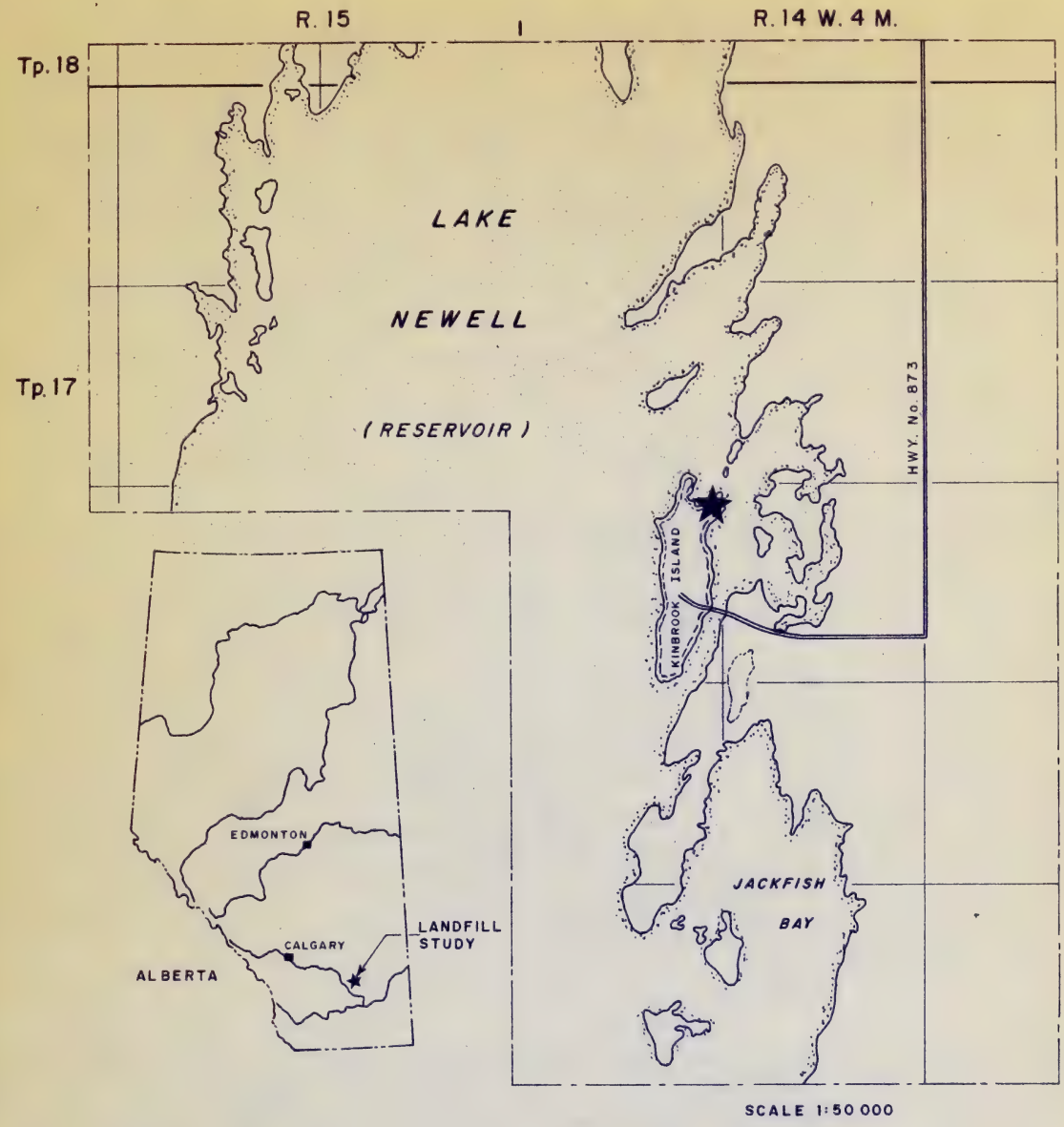
- groundwater in the immediate vicinity of the landfill has been contaminated by leachate as evidenced by elevated chloride and TDS concentrations. However, the level of contamination is very low;

- intrusion of Lake Newell water has apparently freshened shallow groundwater in part of the study area to a better quality than background groundwater;

- no inorganic constituents in the water from the lake exceed upper limits for CDWS.

Recommendations

- no remedial action necessary because landfill leachate has had a minimal impact on shallow groundwater and lake water quality.

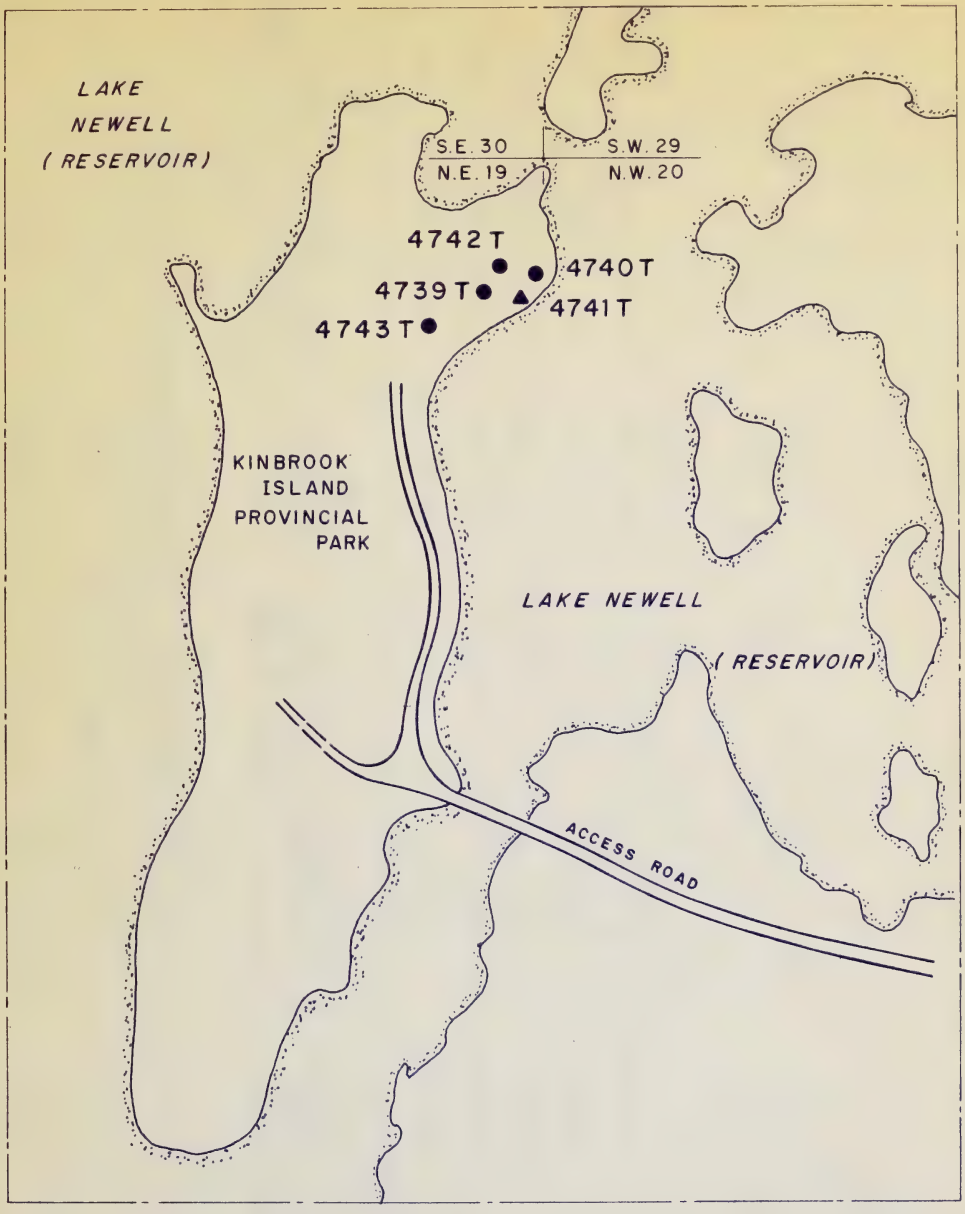


LEGEND:

★ LANDFILL SITE

KINBROOK ISLAND PROVINCIAL PARK

Alberta ENVIRONMENT EARTH SCIENCES DIVISION		KINBROOK ISLAND LANDFILL STUDY
SUBMITTED W.J. Lewis DATE Oct. 27/86	DESIGNED W. CEROICI CHECKED W. CEROICI	LOCATION PLAN
APPROVED [signature] DATE Oct. 27/86	DRAWN H.O CHECKED	SCALE —— SHEET OF DATE 1986 SEPT FIGURE No. 1



LEGEND:

4742T ● WATER TABLE WELL

4741T ▲ PIEZOMETER

Alberta ENVIRONMENT EARTH SCIENCES DIVISION		KINBROOK ISLAND LANDFILL STUDY
SUBMITTED W. J. Keroi DATE Oct 27/86	DESIGNED W. CEROICI CHECKED W. CEROICI	SITE PLAN (N.E.19, Tp.17, R.15, W.4M.)
APPROVED J. Gorrie Cracken DATE Oct 27/86	DRAWN H. O. CHECKED	SCALE 1:10000 APPROX. SHEET OF DATE 1986 SEPT. FIGURE No. 2

TABLE 1

MONITORING WELL COMPLETION INFORMATION AND WATER LEVEL DATA
KINBROOK ISLAND PROVINCIAL PARK PRIORITY 1 LANDFILL INVESTIGATION
Pt. Sec. 19-17-14-W4

Observation Well #	Type of Observation Well	Date Installed	Observation Well Depth (M)	Height of Pipe Above Ground Surface (M)	Screened Interval (M)	1986-02-11 Depth	1986-02-11 Elev.	Expected Water Levels ** Depth	Expected Water Levels ** Elev.
4739-T	WTW	1986-02-11	4.55	0.75	0.80 - 4.55	4.30*	N/A	0.50	N/A
4740-T	WTW	1986-02-11	4.60	0.90	1.70 - 4.60	0.65	N/A	0.60	N/A
4741-T	PIEZ	1986-02-11	3.80	0.90	3.30 - 3.80	3.70*	N/A	0.75	N/A
4742-T	WTW	1986-02-11	3.45	0.90	1.20 - 3.45	0.95	N/A	0.50	N/A
4743-T	WTW	1986-02-11	4.30	0.85	2.05 - 4.30	4.20*	N/A	1.75	N/A

* Not Static Level
** Based on Drill Hole Log

TABLE 2

KINBROOK ISLAND PROVINCIAL PARK LANDFILL INVESTIGATION (PRIORITY 1)

Pt. Sec. 19-17-14-W4
Groundwater Chemistry Analyses

Well Number	Lake Newell	4739-T	4740-T	4742-T	4743-T	CDWS*
Type/Depth (m)	below ice	WTW/4.55	WTW/4.60	WTW/3.45	WTW/4.30	
Lab Data						
pH	7.70	8.10	8.04	8.07	8.19	
EC (mS/cm)	0.39	10.07	1.70	6.84	7.97	
SAR	0.50	13.00	1.80	6.10	11.00	
LAB ANALYSIS						
Inorganic (mg/L)						
Hardness	217.50	3600.00	850.00	3420.00	2750.00	500.
Ca	53.0	440.00	191.00	420.00	410.00	NE**
Mg	20.66	607.50	90.52	575.91	419.18	150.
Na	16.10	1805.50	121.90	823.40	1368.50	300.
HCO_3	212.28	1308.45	664.29	1146.19	824.11	NE
Cl	6.20	112.55	10.64	60.26	50.52	250.
SO_4	62.40	6000.00	518.40	4032.00	4800.00	500.
K	2.35	14.47	7.82	2.35	15.64	NE
NO_3-N	0.14	2.31	0.77	4.06	7.77	10.
NH_4-N	0.07	0.49	0.49	0.21	0.49	1.
TDS (mg/L)	266.00	9635.00	1271.00	6496.00	7504.00	1000.
Metals (mg/L)						
Fe	0.04	0.46	0.17	0.13	0.24	0.3
Mn	0.01	0.20	3.88	0.06	0.22	0.05
Cu	0.02	0.06	0.02	0.03	0.03	1.0
Zn	0.01	0.03	0.02	0.02	0.02	5.0
Pb	0.04	0.18	0.07	0.14	0.14	0.5
Organic (mg/L)						
COD	11.00	197.00	67.00	134.00	661.00	

* CDWS Canadian Drinking Water Standard
** NE Not Established

TABLE 3

KINBROOK PROVINCIAL PARK LANDFILL INVESTIGATION (PRIORITY 1)
Pt. Sec. 19-17-14-W4
Laboratory Soil Analyses

Site Description	4739-T				
Depth (m)	0.00 - 0.25	0.50 - 0.75	1.00 - 1.50	1.75 - 2.25	2.50 - 3.00
Lab Data					
pH	7.44	7.85	7.92	7.91	7.92
EC (d/m)	8.70	7.64	7.84	8.87	8.84
SAR	8.54	8.95	9.02	10.64	10.64
Cations (meq/L)					
Ca	22.5	22.3	22.6	24.1	24.7
Mg	54.6	37.7	38.9	39.5	38.9
Na	53.0	49.0	50.0	60.0	60.0
K	0.69	0.31	0.34	0.48	0.61
NH_4-N	0.245	0.045	0.050	0.050	0.070
Anions (meq/L)					
HCO_3	4.15	2.10	2.11	2.05	2.16
SO_4	121.0	103.0	106.0	110.0	112.0
CL	2.95	1.475	2.45	9.50	0.625
NO_3-N	0.020	0.095	0.040	0.055	0.085
Extractable Cations (meq/L)					
% Total Carbon	1.31	1.48	0.94	0.82	0.39
Lime Equivalent					
% $CaCO_3$	0.99	2.11	3.17	1.78	1.98
Metals (mg/L)					
Cu	6.70	0.96	1.50	1.20	0.88
Zn	4.68	1.06	0.98	0.80	0.86
Pb	1.92	0.74	0.86	0.88	0.78
Cr	0.04	0.06	0.04	0.04	0.06
Ni	2.60	1.38	1.72	0.88	1.30
Cd	0.10	0.06	0.06	0.10	0.08
Mechanical					
% Sand (S)	46.0	62.8	61.2	55.4	61.6
% Clay (C)	27.4	17.6	19.4	21.2	16.2
% Silt (Si)	26.6	19.6	19.4	23.4	22.2
Texture	CS	SiS	SiS	CS	SiS

TABLE 3 continued

Site Description	4740-T				
Depth (m)	0.00 - 0.25	0.75 - 1.50	2.00 - 2.50	2.50 - 3.00	3.00 - 4.50
Lab Data					
pH	7.56	7.88	7.84	7.79	7.85
EC (mS/cm)	5.02	0.92	0.83	1.08	5.24
SAR	3.34	1.39	1.05	1.74	6.56
Cations (meq/L)					
Ca	25.9	4.25	4.15	4.85	24.2
Mg	29.1	3.30	3.15	3.70	17.3
Na	17.5	2.7	2.0	3.6	29.9
K	1.33	0.33	0.32	0.31	0.39
NH_4-N	0.545	0.020	0.030	0.030	0.030
Anions (meq/L)					
HCO_3	4.67	2.61	2.15	2.39	2.03
SO_4	67.0	7.0	6.35	9.0	67.4
CL	1.30	0.675	0.425	0.500	0.625
NO_3-N	0.025	0.045	0.310	0.165	0.640
Extractable Cations (meq/100g)					
% Total Carbon	2.41	1.14	0.61	0.71	0.73
Lime Equivalent					
% $CaCO_3$	2.31	4.62	1.98	1.45	2.11
Metals (mg/L)					
Cu	10.00	0.66	0.54	0.46	1.30
Zn	12.00	1.06	0.94	1.26	1.32
Pb	7.02	0.54	0.44	0.40	0.66
Cr	0.04	0.02	0.02	0.02	0.04
Ni	2.02	0.98	1.72	1.22	1.42
Cd	0.08	0.04	0.06	0.06	0.10
Mechanical					
% Sand (S)	64.8	61.6	71.8	83.6	47.8
% Clay (C)	16.0	11.0	9.0	8.0	14.0
% Silt (Si)	19.2	27.4	19.2	8.4	38.2
Texture	SiS	SiS	SiS	S	SiS

TABLE 3 continued

Site Description	4741-T				
Depth (m)	0.00 - 0.50	1.00 - 1.50	2.00 - 2.50	4.00 - 5.50	7.00 - 7.25
Lab Data					
pH	7.54	7.73	7.72	8.16	7.87
EC (mS/cm)	5.15	2.43	3.67	8.00	6.25
SAR	3.75	1.13	2.70	20.12	20.15
Cations (meq/L)	25.0	19.5	27.5	12.6	8.0
Mg	30.7	12.0	12.0	13.0	8.0
Na	19.8	4.5	12.0	72.0	57.0
K	0.57	0.22	0.33	0.54	0.61
NH_4-N	0.095	0.030	0.040	0.085	0.095
Anions (meq/L)					
HCO_3	4.30	2.26	1.93	1.52	2.09
SO_4	69.0	29.5	49.2	96.0	69.0
CL	1.00	0.400	0.250	1.175	0.825
NO_3-N	0.025	0.060	0.075	0.715	1.50
Extractable Cations (meq/100g)					
% Total Carbon	1.27	1.31	0.71	0.96	0.38
Lime Equivalent					
% $CaCO_3$	3.69	5.23	1.32	2.08	0.47
Metals (mg/L)					
Cu	5.60	0.82	0.78	2.04	5.22
Zn	4.38	1.14	0.90	2.52	6.80
Pb	2.22	0.78	0.78	0.94	2.72
Cr	0.04	0.02	0.04	0.04	0.04
Ni	2.26	1.92	2.06	2.72	5.34
Cd	0.06	0.04	0.08	0.12	0.20
Mechanical					
% Sand (S)	64.0	71.8	69.8	52.0	24.8
% Clay (C)	17.0	16.2	11.0	23.2	48.2
% Silt (Si)	19.0	12.0	19.2	24.8	27.0
Texture	SiS	SiS	SiS	CS	SiC

TABLE 3 continued

Site Description	4743-T		
Depth (m)	0.00 - 1.50	1.50 - 3.00	3.00 - 4.50
Lab Data			
pH	8.02	7.95	7.94
EC (mS/cm)	10.99	7.31	6.65
SAR	11.03	7.38	8.44
Cations (meq/L)			
Ca	21.6	22.3	22.9
Mg	70.8	42.5	26.6
Na	75.0	42.0	42.0
K	0.55	0.38	0.45
NH_4-N	0.055	0.040	0.040
Anions (meq/L)			
HCO_3	1.65	1.56	1.79
SO_4	162.0	102.0	91.2
CL	3.250	1.050	0.700
NO_3-N	0.120	0.170	0.275
Extractable **Cations (meq/100g)**			
% Total Carbon	1.10	0.57	1.02
Lime Equivalent			
% $CaCO_3$	6.70	2.01	2.68
Metals (mg/L)			
Cu	1.56	1.48	1.90
Zn	1.52	1.08	1.70
Pb	0.44	0.82	0.90
Cr	0.04	0.04	0.04
Ni	0.54	0.70	1.22
Cd	0.04	0.08	0.10
Mechanical			
% Sand (S)	53.4	41.4	41.6
% Clay (C)	24.4	25.4	18.4
% Silt (Si)	22.2	33.2	40.0
Texture	CS	CS	SSi

GROUNDWATER PROTECTION BRANCH DRILL HOLE LOG

Land Location: Pt. Sec. 19-17-14-W4

Date: February 11, 1986 Supervisor: Geoffrey E. Nash

Project: Kinbrook Island Priority One Landfill

Test Hole 4739-T to 4743-T

DEPTH (m)	TEXTURE AND LITHOLOGY	MOISTURE CONTENT*
4739-T		
0.00 - 0.25	Topsoil, brown, thin layer of sands and silt.	vm
0.25 - 1.50	Lacustrine, brown, sandy silt.	sat
1.50 - 2.25	Glacio-fluvial, brown, silty sands, meltwater deposits.	sat
2.25 - 3.50	Glacio-fluvial, brown, coarse sands and silt, post glacial meltwater deposits.	sat
3.50 - 4.50	Glacio-fluvial brown, coarse sands.	vm-sat
4740-T		
0.00 - 0.25	Lacustrine, brown.	vm
0.25 - 1.00	Lacustrine, brown, sandy silt.	sat
1.00 - 1.75	Glacio-fluvial, brown, coarse sands and silt, meltwater deposit.	sat
1.75 - 2.75	Glacio-fluvial, brown, coarse sands and silt, meltwater deposit.	sat
2.75 - 4.50	Lacustrine, brown, silty sand, varving.	vm-sat
4741-T		
0.00 - 0.50	Lacustrine, brown.	m-vm
0.50 - 1.00	Lacustrine, brown, coarse sands and silt.	sat
1.00 - 4.00	Glacio-fluvial, brown, meltwater deposits.	sat

*Moisture Content: d(dry); sm(slightly moist); m(moist); vm(very moist); s(saturated).

DEPTH (m)	TEXTURE AND LITHOLOGY	MOISTURE CONTENT*
4741-T continued		
4.00 - 4.75	Till, reddish brown, heavily oxidized.	m
4.75 - 5.80	Till, brown, sandy till, oxidized.	m
5.80 - 6.00	Glacio-fluvial sands, brown, medium grained.	m
6.00 - 6.50	Till, brown.	m
6.50 - 7.00	Siltstone, olive green, fine textured bedrock, Oldman Formation, thin bedded and multi-hued.	m
7.00 - 7.25	Shale, grey-brown, silty shale, Oldman Formation, heavily bedded and multi hued.	m
7.25 - 7.60	Sandstone, grey, argillaceous, sand stone, Oldman Formation, heavily bedded and multi-hued.	m
4742-T		
0.00 - 0.50	Lacustrine, brown, sandy silt.	m-vm
0.50 - 1.00	Lacustrine, brown, sandy silt.	vm-sat
1.00 - 3.75	Glacio-fluvial, brown, coarse sands and silts, meltwater deposits.	sat
3.75 - 4.25	Till, reddish brown, heavily oxidized silty.	vm
4.25 - 4.50	Till, reddish brown, sandy, oxidized.	m
4743-T		
0.00 - 0.25	Topsoil, thin layer.	m
0.25 - 1.75	Lacustrine, clay sands.	m-vm
1.75 - 2.00	Lacustrine, silty, varved.	sat
2.00 - 2.50	Glacio-fluvial, sands and silt.	sat
2.50 - 3.75	Lacustrine, silty, varved.	vm-sat
3.75 - 4.25	Till, very sandy, no structure.	vm
4.25 - 4.50	Till, sandy, more structure.	vm

*Moisture Content: d(dry); sm(slightly moist); m(moist); vm(very moist); s(saturated).

APPENDIX B

CLASS 1 AND 2 LANDFILL UPDATES

EDSON MUNICIPAL LANDFILL
NE 09-53-17-W5

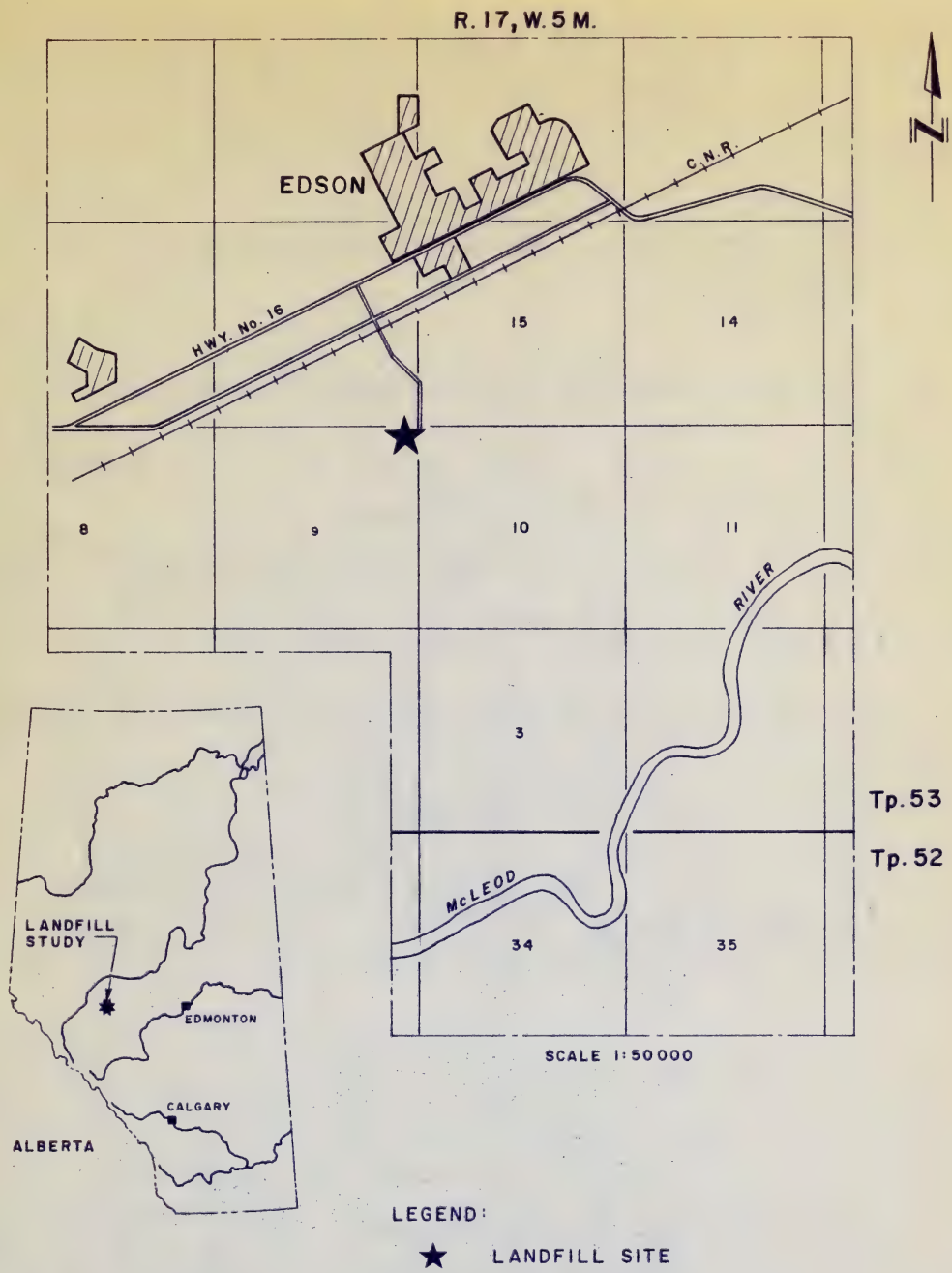
The Edson landfill, located approximately 1 km south of Edson (Figure 1), is an active site. The Phase III report concluded that groundwater in close proximity to the refuse is contaminated with inorganic and organic compounds. However, the level of contamination is insignificant, and does not pose a threat to the environment. The report recommended that replicate samples be collected and analyzed to confirm the low level of contamination and that additional groundwater instrumentation be installed to explore groundwater quality conditions south of the landfill.

Four additional water table wells and two piezometers were completed south of the landfill in January 1986 (Figure 2) since the area could not be accessed in the previous field program. Lithologic and completion details of new instrumentation are attached.

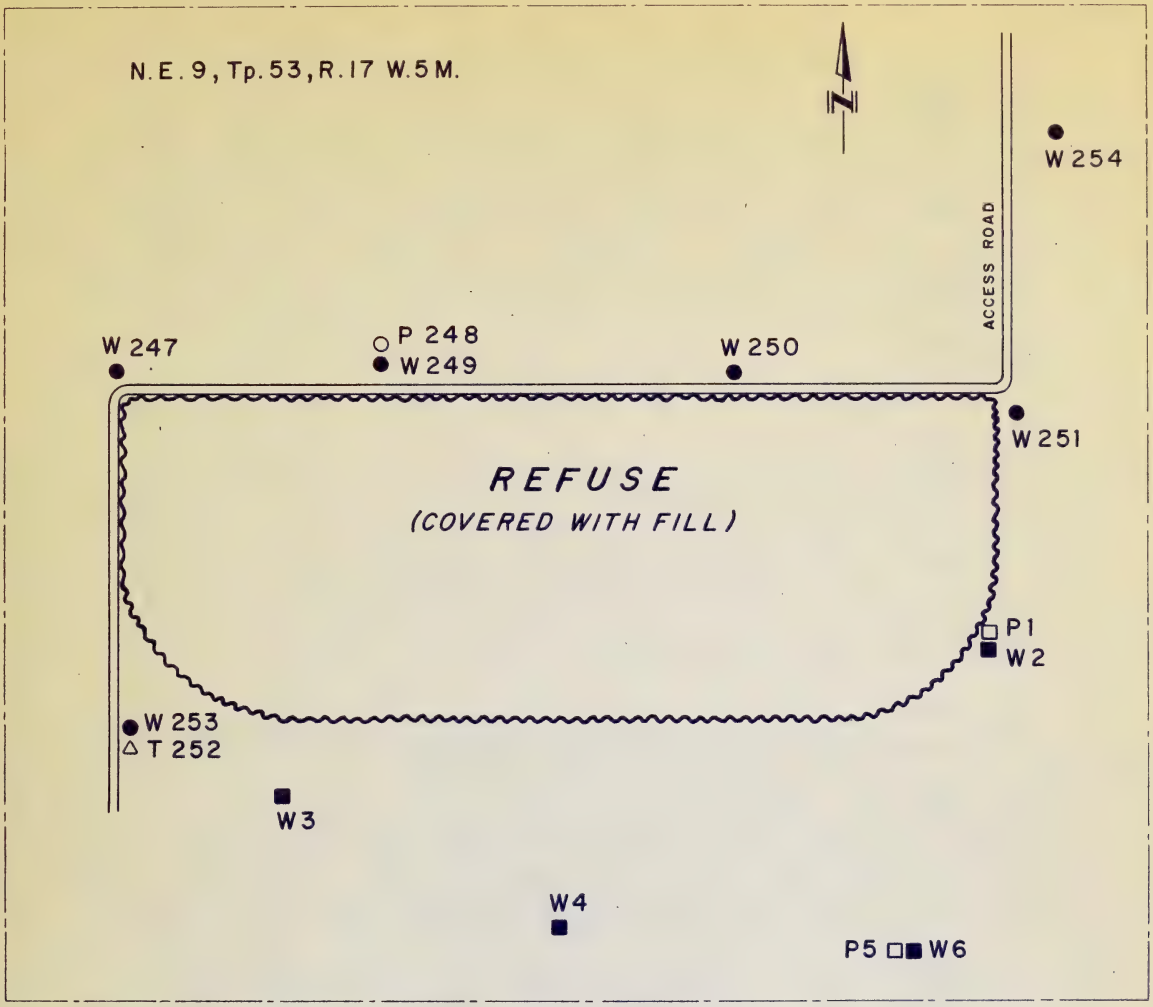
Samples were collected from P1, W2, W3, W4, P5, W6 and P248 for complete analysis (inorganics, metals and TOC) and from W247, W249, W250, W251, W253 and W254 on March 11, 1986 for analysis of TOC and chloride (Table 1). Analytical results of samples collected on August 22, 1985 are presented in Table 2 for comparative purposes.

The new chemical data support previous results by indicating that groundwater contamination is limited to the immediate area of the landfill. The low hydraulic conductivity of the underlying clay material and low hydraulic gradient has effectively limited the lateral and vertical movement of leachate-contaminated groundwater from the site.

Due to lack of significant groundwater contamination it is recommended that the site be assigned a lower priority and that monitoring at the site be discontinued. Some remedial action may be required to prevent the contamination of surface water in the cutoff ditch constructed along the east and south sides of the disposal area.



Alberta ENVIRONMENT EARTH SCIENCES DIVISION		EDSON LANDFILL STUDY	
SUBMITTED W.J. Cerovici DATE Oct 27/86	DESIGNED W. CEROICI CHECKED W. CEROICI	LOCATION PLAN	
APPROVED DATE Oct 27/86	DRAWN H. O. CHECKED	SCALE — DATE 1986 SEPT.	SHEET OF FIGURE No. 1



LEGEND:

T 252 △	TESTHOLE	INSTALLED 1985, MAY
W 247 ●	WATER TABLE WELL	
P 248 ○	PIEZOMETER	
W 6 ■	WATER TABLE WELL	INSTALLED 1986, JANUARY
P 5 □	PIEZOMETER	

Alberta ENVIRONMENT EARTH SCIENCES DIVISION		EDSON LANDFILL STUDY	
SUBMITTED W. J. Cieroici DATE Oct 27/86	DESIGNED W. CEROICI CHECKED W. CEROICI	SITE PLAN (N.E.9, Tp.53, R.17, W.5M.)	
APPROVED Dave Quiche DATE Oct. 27/86	DRAWN H.O. CHECKED	SCALE 1: 1250 DATE 1986 SEPT.	SHEET OF FIGURE No. 2

TABLE 1. CHEMICAL ANALYSES RESULTS (86/03/11)

	Well Numbers												
	P1	W2	W3	W4	P5	W6	W247	P248	W249	W250	W251	W253	W254
LAB DATA													
pH	7.2	7	6.8	6.7	-	7	-	8.6	-	-	-	-	-
EC(mS/cm)	0.61	0.53	0.7	0.65	-	0.5	-	7	-	-	-	-	-
SAR	0.2	-	-	-	-	-	-	-	-	-	-	-	-
LAB ANALYSIS (all parameters in mg/L)													
Inorganic													
Ca	109	108	153	134	-	105	-	101	-	-	-	-	-
Mg	23	16	23	21	-	13	-	28	-	-	-	-	-
$CaCO_3$ (T.Hard)	368	336	477	422	-	316	-	368	-	-	-	-	-
Na		4	9.2	9.8	-	4.1	-	0.8	-	-	-	-	-
K	1.6	0.7	1.4	2.6	-	0.6	-	1.9	-	-	-	-	-
HCO_3	463	400	564	502	-	362	-	469	-	-	-	-	-
$CaCO_3$ (T.Alk.)	379	328	477	412	-	297	-	385	-	-	-	-	-
SO_4	4.8	5	<5	<5	-	<5	-	19	-	-	-	-	-
Cl^-	0.9	1	22	17	-	15	1	3.5	99	720	18	5	1
NO_3-N^+ NO_2-N^-	0.4	<1	<1	<1	-	<1	-	0.07	-	-	-	-	-
NH_4-N	0.14	-	-	-	-	-	-	<0.07	-	-	-	-	-
TDS	376	332	487	432	-	316	-	403	-	-	-	-	-
Organic													
TOC	-	16	31	55	-	15	8	-	13	65	8	63	11
Metals													
Fe	9.3	0.42	0.6	1.7	0.1	0.08	0.06	0.02	0.15	0.13	0.03	3.35	0.04
Mn	0.34	1.10	0.5	0.4	0.68	0.40	0.34	0.24	3.10	0.42	0.18	1.80	0.02
Cu	0.01	0.01	0.01	0.01	0.01	0.01	<0.01	<0.01	0.01	0.02	0.01	0.01	0.01
Zn	0.03	0.01	0.02	0.02	0.03	0.04	0.02	0.02	0.03	0.02	0.02	0.04	0.01
Pb	0.03	0.03	0.03	0.04	0.03	0.02	0.02	0.02	0.03	0.08	0.03	0.03	0.02

	Well Numbers							
	247	248	249	250	251	253	254	C.D.W.S.# *
FIELD DATA								
Temp. (°C)	.65	.65	.85	4.0	1.2	.9	.6	
pH	7.8	8.3	7.7	7.6	7.4	8.2	7.9	
LAB DATA								
pH	7.2	7.3	7.3	6.9	7.2	6.4	7.3	
EC (mS/cm)	.62	6.2	9.8	3.1	1.2	.9	.5	
SAR	.33	.38	.74	.25	.50	.45	.11	
LAB ANALYSIS (all parameters in mg/L)								
Inorganic								
Ca	94	93	174	476	180	156	91	NE**
Mg	25.2	25.2	23.4	93.0	32.4	23.4	18.6	150
$CaCO_3$ (T.Hard)	340	337.5	465	1575	585	487.5	350	500
Na	13.9	16.2	37.0	23.1	27.7	23.1	4.2	300
K	2.35	2	2	3.1	4.3	2.4	1.2	NE
HCO_3	455	462	431	791	513	583	337	NE
$CaCO_3$ (T.Alk)	374	375	580	1316	687	560	277	500
SO_4	12	9.6	74.4	98.4	60	60	36	500
Cl	<1.77	<1.77	84.19	630.37	124	7.98	7.98	250
NO_3-N+NO_2-N	.14	.07	.14	.56	.28	.07	.14	10
NH_4-N	.35	.14	.14	.21	.14	.49	.14	.5
TDS	374	375	580	1316	687	560	326	1000
Orgnaic								
COD	6	6	26	93	50	60	2	
TOC	140.2	115.5	115.5	244.2	142.8	219.5	84.1	
TIC	2.2	3.4	6.7	8.3	14.5	16.6	6.6	
TC	142.4	118.9	122.2	252.5	157.3	236.1	90.7	
Metals								
Fe	.13	.03	.05	.07	.06	10.00	.04	.3
Mn	.45	.23	1.18	.32	.18	2.79	.01	.05
Cu	.01	<.01	.01	.01	.01	.01	.01	1.0
Zn	.01	.01	.01	.02	.01	.06	.01	5.0
Pb	.04	.05	.05	.11	.06	.02	.05	.05

* Canadian Drinking Water Standards

** Not Established

SOILS BRANCH DRILL HOLE LOG

Land Location NE Sec. 9 Tp. 53 R. 17 W. 6

Date January 21, 1986 Supervisor deBrentani

Project Edson Landfill

Test Hole 1 to 6 inclusive.

Test Hole 1

DEPTH (m)	TEXTURE AND LITHOLOGY	MOISTURE CONTENT*
0-1.5	peatmoss	s
0.5-1.5	sand, brown, fine, silty, iron oxide streaks	s
1.5-7.0	sand, grey, fine, silty	s
7.0-8.0	clay, grey, plastic	s

Completion: Piezometer, depth 5 m, screened interval 4-5 m, 50 mm PVC pipe

Test Hole #2

0-10	as TH #1	

Completion: Water table well, depth 3 m, slotted interval 1.5-3 m, 50 mm PVC pipe

Test Hole #3

0-4.0	peatmoss	s
4.0-4.2	bentonitic, soft to granular light grey	s
4.2-6.0	clay, grey, plastic	s

Completion: Water table well, depth 4.5 m, slotted interval 1.5-4.5 m, 50 mm PVC pipe

Moisture Content: d(dry); sm(slightly moist); m(moist); vm(very moist); s(saturated)

#416

DEPTH (m)	TEXTURE AND LITHOLOGY	MOISTURE CONTENT*
Test Hole #4		
0-4.0	peatmoss	s
4.0-4.1	bentonite, light grey	s
4.1-6.0	clay, grey, plastic	

Completion: Water table well, depth 5.5 m, slotted interval 2.5-5.5 m, 55 mm PVC pipe

Test Hole #5		
0-1.0	sand, yellow, fine	vm
1.0-1.5	sand, yellow brown, fine, silty, blocky	d
1.5-7.0	sand, grey, fine, silty	s
7.0-8.0	clay, grey, plastic	s

Completion: Piezometer, depth 6 m, screened interval 5-6 m, 50 mm PVC pipe

Test Hole #6		
0-4.5	as TH #5	

Completion: Water table well, depth 4.5 m, slotted interval 1.5-4.5 m, 50 mm PVC pipe

Moisture Content: d(dry); sm(slightly moist); m(moist); vm(very moist); s(saturated)

GLENWOOD LANDFILL

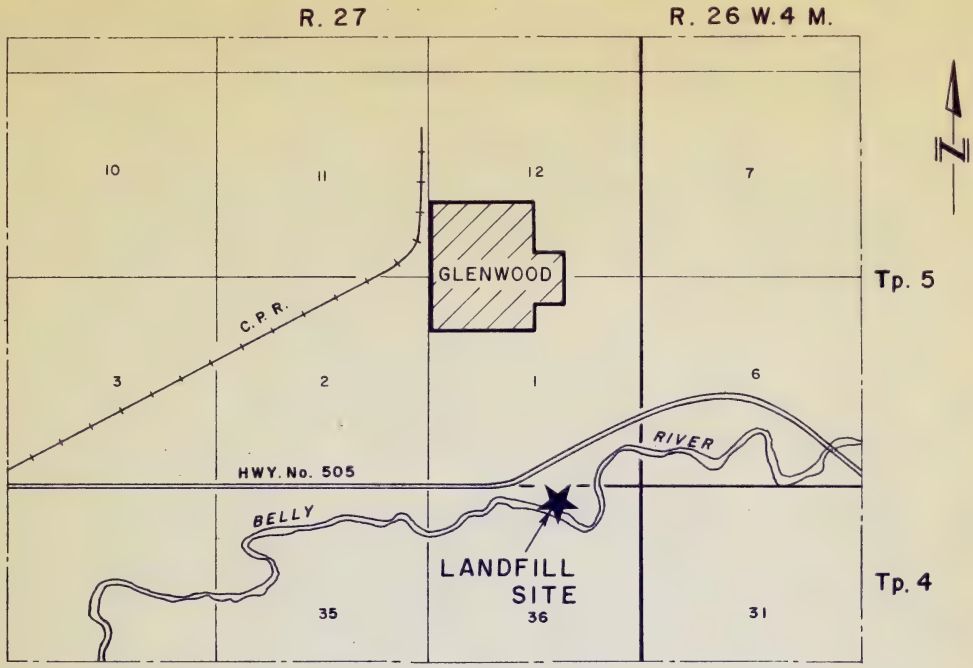
pt. N.W. 36-4-27-W4 and pt. S.W. 1-5-27-W4

The Glenwood landfill site is located about 1 km south of the village of Glenwood (Figure 1). The Phase III hydrogeological investigation at the site concluded that groundwater in the vicinity of the landfill is contaminated and that water in the Belly River has not been polluted. No remedial action was recommended. However, it was recommended that additional instrumentation be installed to determine the areal extent of groundwater contamination.

Seven water table wells were added to the monitoring system at the site in February 1985 (Figure 2). Borehole logs and monitoring well completion information for new instrumentation are attached.

Groundwater samples were collected on June, 1985 for chemical analysis. Analytical results (Table 1) indicate that shallow groundwater is predominantly the calcium-magnesium/bicarbonate type. Information about the areal extent of the chloride concentration (Figure 3) was used to determine the extent of groundwater contamination. The chloride ion is a good indicator of contamination because it is non-reactive and relatively mobile in the aqueous environment. At the time of sampling, leachate in the landfill trench had a chloride concentration of approximately 1400 mg/L. The chloride concentration in groundwater tends to be highest in the immediate vicinity of the landfill suggesting groundwater contamination is limited to this area. At nest 3660-T, the chloride concentration in the deep piezometer is significantly less than the chloride concentration in the adjacent water table well. This indicates that the low permeability of surficial materials effectively reduces the downward migration of contaminants.

The results of additional groundwater monitoring at the site confirm Phase III study conclusions that groundwater contamination is limited to the immediate vicinity of the landfill and the Belly River water quality has not been affected. In light of the conclusions it is recommended the site be down-graded to Class 3 and that groundwater monitoring activities at the site cease.

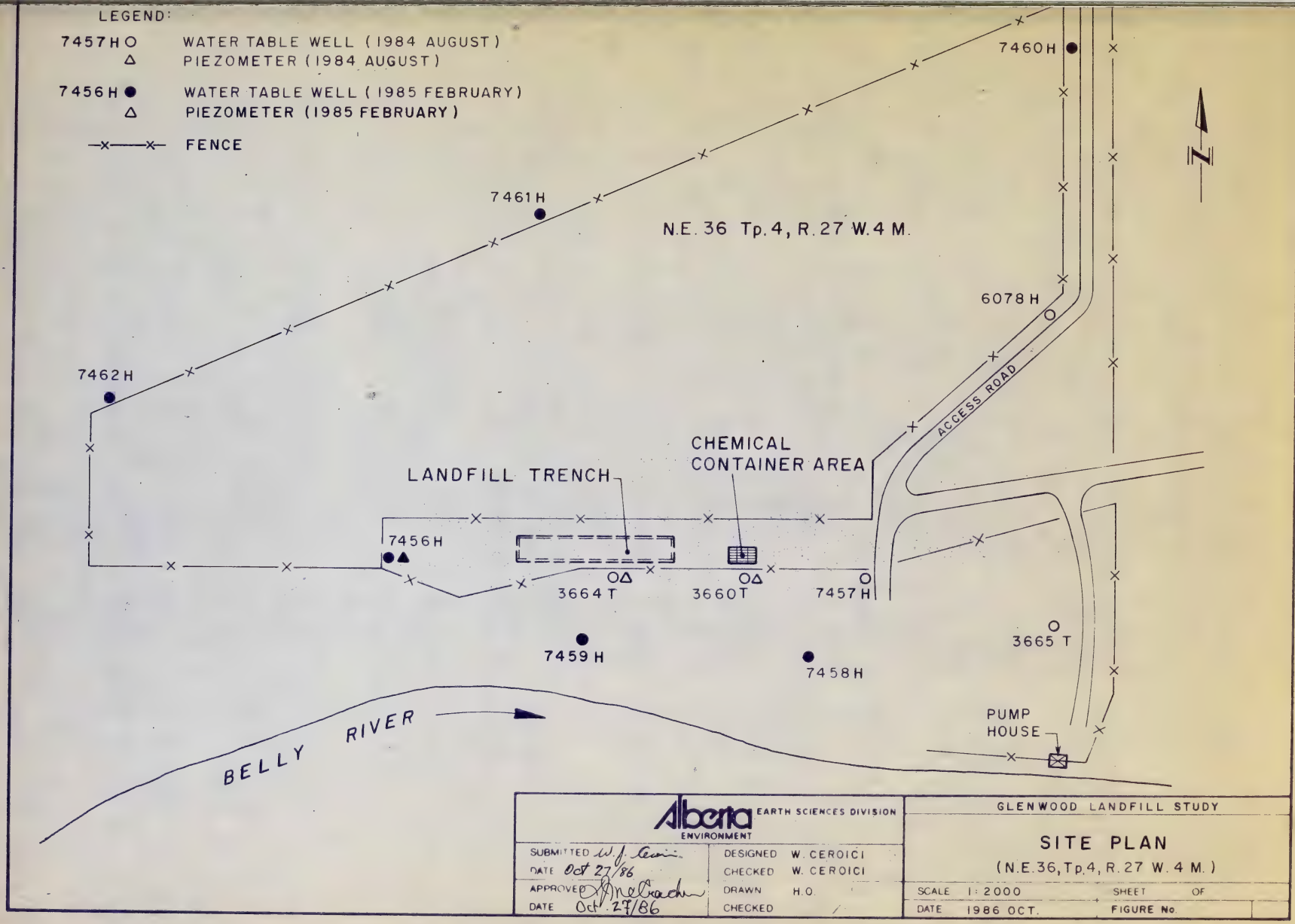


Alberta ENVIRONMENT — EARTH SCIENCES DIVISION

GLENWOOD LANDFILL STUDY

LOCATION PLAN

SUBMITTED W. I. Teroi	DESIGNED W. CEROICI	SCALE ——	SHEET OF
DATE Oct 27/86	CHECKED W. CEROICI	DATE 1986 OCT.	FIGURE No. 1
APPROVED L. McQuade	DRAWN H.Q.		
DATE Oct 27/86	CHECKED		



Alberta ENVIRONMENT EARTH SCIENCES DIVISION

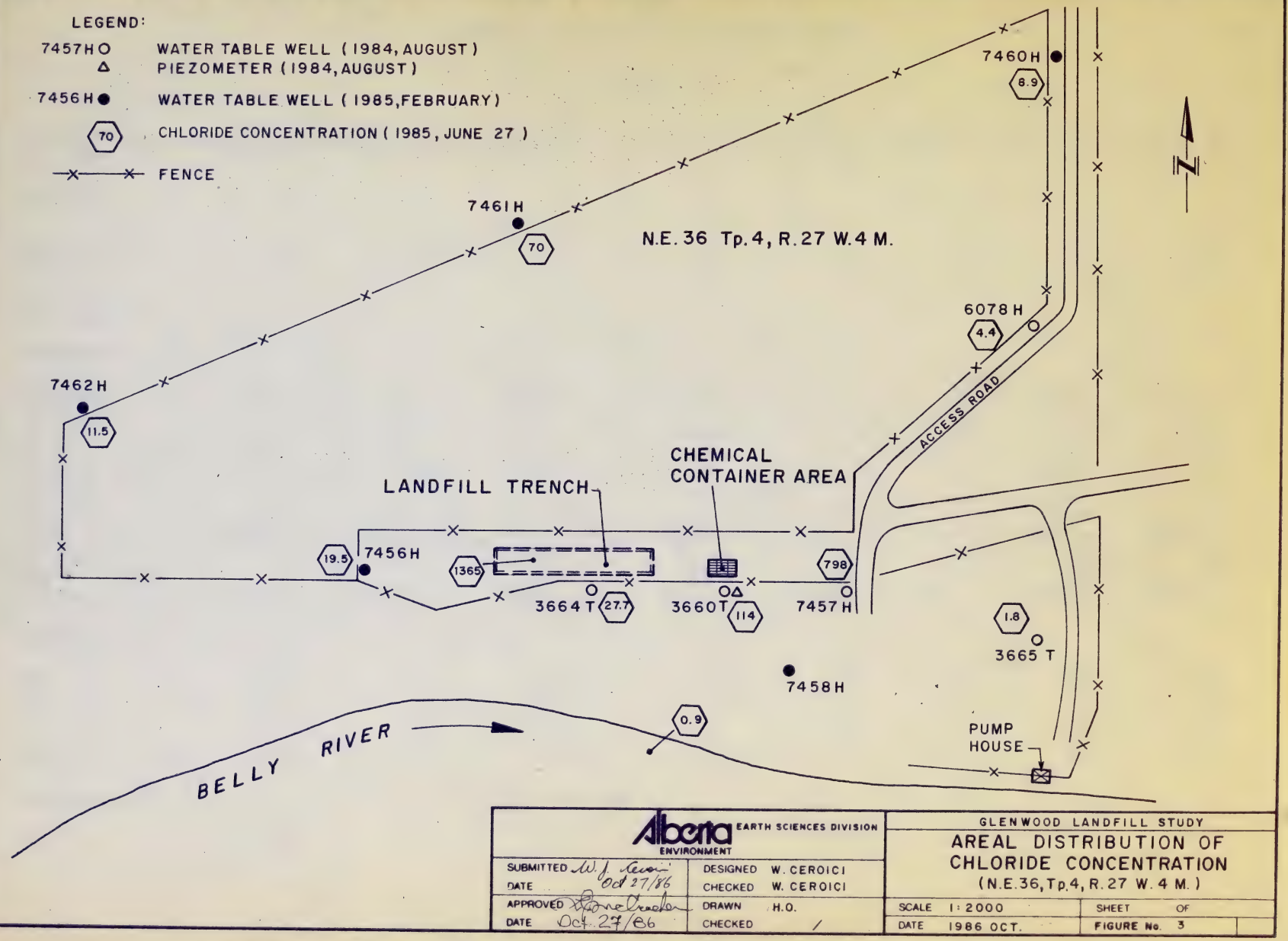
SUBMITTED W.J. Geroici		DESIGNED	W. CEROICI
DATE Oct 27/86		CHECKED	W. CEROICI
APPROVED J.M. Cherry		DRAWN	H.O.
DATE Oct. 27/86		CHECKED	

GLENWOOD LANDFILL STUDY

SITE PLAN

(N.E.36, Tp.4, R.27 W.4 M.)

SCALE	1:2000	SHEET	OF
DATE	1986 OCT.	FIGURE No.	



Alberta ENVIRONMENT EARTH SCIENCES DIVISION

SUBMITTED W.J. Keroici	DESIGNED W. CEROICI
DATE Oct 27/86	CHECKED W. CEROICI
APPROVED Diane Tracker	DRAWN H.O.
DATE Oct. 27/86	CHECKED /

GLENWOOD LANDFILL STUDY

AREAL DISTRIBUTION OF CHLORIDE CONCENTRATION (N.E.36, Tp.4, R.27 W.4 M.)

SCALE 1:2000	SHEET OF
DATE 1986 OCT.	FIGURE No. 3

TABLE 1
Glenwood Landfill Monitoring Investigation
Pt. N.W. 36-4-27-W4 and Pt. S.W. 1-5-27-W4
Groundwater Chemistry Analyses
1985-05-27

Well Number	3660-T (1)	3660-T (2)	3664-T (1)	3664-T (2)	3665-T	6078-H	7456-H (1)	7456-H (2)
Type/Depth (m)	WTW/22.45	WTW/5.23	WTW/5.98	PIEZ/6.44	WTW/5.59	WTW/5.61	WTW/23.51	WTW/7.15
Lab Data								
pH	7.63	7.73	7.83	7.75	7.72	8.05	7.76	7.86
EC (mS/cm)	4.01	8.55	6.88	6.20	0.65	1.50	5.05	6.42
SAR	1.80	5.90	5.80	5.60	0.40	0.70	2.90	5.90
LAB ANALYSIS								
Inorganic (mg/L)								
Hardness	2460.0	4650.0	3400.0	2940.0	350.0	8.20	2770.0	4425.0
Ca	522.0	480.0	452.0	446.0	92.0	100.0	508.0	440.0
Mg	280.66	838.35	551.61	443.48	29.16	138.51	364.5	807.98
Na	204.7	931.5	784.3	692.3	18.4	48.3	351.9	908.5
HCO_3	506.30	406.87	436.76	350.75	400.77	753.35	487.39	500.81
CO_3								
Cl	10.64	114.33	27.47	22.16	1.77	4.43	39.88	19.50
SO_4	2304.0	5712.0	4368.0	3840.0	59.52	286.08	2851.20	5592.00
K	12.12	16.03	13.68	15.64	1.96	1.96	16.81	19.16
NO_3-N	0.255	0.080	0.005	0.005	0.005	0.040	0.050	0.005
TDS (mg/L)	3600.0	8300.0	6410.0	5630.0	400.0	952.0	4380.0	8030.0
Metals (mg/L)								
Fe	1.10	0.09	0.25	0.13	0.08	0.38	0.10	0.13
Mn	0.18	0.09	1.82	0.53	0.15	0.05	1.77	0.36
Cu	0.03	0.03	0.02	0.02	0.01	0.01	0.02	0.03
Zn	0.04	0.04	0.03	0.37	0.04	0.03	0.26	0.14
Pb	0.08	0.13	0.10	0.11	0.02	0.04	0.10	0.15
Organic (mg/L)								
COD	17.0	58.0	40.0	70.0	10.0	30.0	37.0	58.0

TABLE 1 (Continued)

Glenwood Landfill Monitoring Investigation
Pt. N.W. 36-4-27-W4 and Pt. S.W. 1-5-27-W4
Groundwater Chemistry Analyses
1985-06-27

Well Number	7457-H	7460-H	7461-H	7462-H	Belly River*	Landfill Trench*	CDWS**
Type/Depth (m)	WTW/9.45	WTW/7.53	WTW/9.47	WTW/7.82	at Pump House	at 3664-T	
Lab Data							
pH	7.85	7.86	7.95	7.93	8.52	8.21	
EC (mS/cm)	6.74	5.92	5.95	4.09	0.16	8.54	
SAR	4.20	2.10	4.5	2.8	0.62	10.5	
LAB ANALYSIS							
Inorganic (mg/L)							
Hardness	3410.0	2220.0	3050.0	2230.0	127.5	2000.0	500.0
Ca	504.0	390.0	480.0	308.0	30.0	80.0	NE***
Mg	522.45	302.54	449.55	354.78	12.76	437.4	150.0
Na	568.1	225.4	575.0	310.5	16.1	1076.8	300.0
HCO_3	525.82	604.51	409.31	543.51	131.15	2606.53	NE
CO_3							NE
Cl	797.62	8.86	70.01	11.52	0.89	1364.82	250.0
SO_4	2880.0	2078.40	3619.20	2284.80	43.2	950.4	500.0
K	13.29	5.47	15.25	8.60	0.78	342.52	NE
NO_3-N	0.110	0.050	0.620	0.005	0.07	0.07	10.0
TDS (mg/L)	5550.0	3310.0	5450.0	3540.0	175.0	5610.0	1000.0
Metals (mg/L)							
Fe	0.22	0.13	0.10	0.33	0.18	1.48	0.3
Mn	1.40	0.08	0.28	1.70	0.01	0.31	0.05
Cu	0.02	0.02	0.03	0.01	0.01	0.02	1.0
Zn	0.07	0.08	0.07	0.03	0.01	0.32	5.0
Pb	0.12	0.10	0.10	0.09	0.06	0.08	0.5
Organic (mg/L)							
COD	144.0	60.0	68.0	57.0	9.4	363.0	

* Sampled 1984-10-23
** Canadian Drinking Water Standard

Land Location Pt. N.W. Sec. 36 Tp. 04 R. 27 W 4
Pt. S.W. 01 05 27 4

Date: August 22, 1984 Supervisor R. M. Coupland

Project Glenwood Landfill Investigation

Test Hole 3660-T, 3664-T, 3665-T and 6078-H

Depth (m)	Texture and Lithology	Moisture Content*
3660-T (1)		
0.0 - 0.75	Lacustrine, sandy silt, traces of gravel	d
0.75 - 2.0	Till, sand and clay, pebbles oxidized	sm
2.0 - 3.0	Till, clay and sand	m
3.0 - 4.5	Till, clay, medium dark brown, pebbles, oxidized	m
4.5 - 5.25	Till, clay, medium dark brown, small amount of fine sand	sm
5.25 - 6.25	Till, fine sandy clay, medium brown, pebbles	m
6.26 - 7.5	Till, fine sandy clay, medium brown, gravelly	sm
7.5 - 10.5	Till, fine sandy clay, medium brown, gravelly	sm
10.5 - 15.2	Till, very fine sandy clay, medium brown, gravelly	sm
15.2 - 17.0	Till, very fine sandy clay dark brown, small pebbles	m
17.0 - 18.6	Till, clay, reduced, black-grey pebbles	m
18.6 - 22.8	Till, clay, reduced, dark brown-grey, tiny pebbles	m

* Moisture Content: d(dry); sm(slightly moist); m(moist); vm(very moist); s(saturated).

Depth (m)	Texture and Lithology	Moisture Content*
3660-T (2)		
0.0 - 5.5	Same as above	
3664-T (1)		
0.0 - 0.5	Topsoil, fine sandy, beige color	d
0.5 - 1.5	Till, sandy, fine grained, light brown	d
1.5 - 3.0	Till, clay, medium brown, sandstone chips, coal	m
3.0 - 4.5	Till, sandy clay, medium brown sandstone chips, coal	m
4.5 - 6.1	Till, sandy clay, yellowish brown, pebbles	sm
3664-T (2)		
0.0 - 6.1	Same as above	
6.1 - 6.5	Till, sandy clay, yellow brown, pebbles	m
3665-T		
0.0 - 1.5	Fill material, sand, clay, garbage, etc	d
1.5 - 2.25	Topsoil, clay, black organic	sm
2.25 - 3.75	Lacustrine, clay, black color	m-sm
3.75 - 4.25	Lacustrine, clay, black color	m-sm
4.25 - 4.5	Fine sand and gravel, grey color	vm-sat
4.5 - 5.8	Till, clay, brown, pebbles, bedrock chips	m
6078-T		
0.0 - 0.3	Topsoil, clayey sand	sm
0.3 - 1.5	Till, clay and sand	m
1.5 - 3.4	Till, sandy clay	vm
3.4 - 6.1	Till, clay	m

* Moisture Content: d(dry); sm(slightly moist); m(moist); vm(very moist); s(saturated).

Land Location Pt. N.W. Sec. 36 Tp 4 R. 27 W 4
Pt. S.W. 1 5 27 4

Date February 1985 Supervisor G. E. Nash

Project Glenwood Regional Landfill

Test Hole 7456-H to 7462-H inclusive.

Depth (m)	Texture and Lithology	Moisture Content*
7456-T (1)		
0.0 - 0.75	Fill, clay	sm
0.75 - 2.0	Till, silty clay, firm, brown	sm
2.0 - 5.0	Till, silty clay, firm, brown	sm-m
5.0 - 7.5	Till, silty clay, firm, brown	m
7.5 - 16.8	Till, clay, firm, brown	sm-m
16.8 - 24.0	Till, clay, firm, reduced, grey	m
7456-T (2)		
0.0 - 7.25	Same as above	
7457-H		
0.0 - 0.5	Topsoil, clay, dark brown	sm
0.5 - 1.75	Till, clay, firm, brown	sm
1.75 - 3.0	Till, clay, firm, brown	m
3.0 - 10.45	Till, clay, firm, brown	sm-m
7458-H		
0.0 - 0.5	Topsoil, clay, brown	sm
0.5 - 1.5	Till, silty clay, hard, beige	d
1.5 - 8.4	Till, clay, firm, light brown	sm
8.4 - 8.75	Glacial fluvial, sand, brown	sm
8.75 - 15.0	Till, clay, brown	sm-m
15.0 - 22.0	Till, clay, reduced, grey	m

* Moisture Content: d(dry); sm(slightly moist); m(moist); vm(very moist); s(saturated).

Depth (m)	Texture and Lithology	Moisture Content*
7459-H		
0.0 - 0.5	Topsoil, clay, brown	sm
0.5 - 1.75	Till, clay, firm, beige	d-sm
1.75 - 15.5	Till, clay, firm, brown	sm-m
15.5 - 25.0	Till, clay, reduced, grey	m
7460-H		
0.0 - 0.5	Topsoil, clay, brown	m
0.5 - 1.5	Till, clay, brown	m-vm
1.5 - 3.25	Till, clay, brown	vm-sat
3.25 - 8.0	Till, clay, firm, brown	vm
7461-H		
0.0 - 0.5	Topsoil, clay, light brown	sm
0.5 - 1.0	Till, clay, firm, light brown	d-sm
1.0 - 1.5	Till, clay, brown	m
1.5 - 2.75	Till, clay, brown	m-vm
2.75 - 8.1	Till, clay, brown	m
8.1 - 9.4	Till, clay, brown	sat
7462-H		
0.0 - 0.25	Topsoil, clay, brown	m
0.25 - 5.6	Till, clay, firm, brown	m-vm
5.6 - 6.1	Sand, medium-fine, brown	sat
6.1 - 9.3	Till, clay, firm, brown	m

* Moisture Content: d(dry); sm(slightly moist); m(moist); vm(very moist); s(saturated).

Glenwood Landfill Monitoring
Monitoring Well Completion Information
Pt. N.W. 36-4-27-W4 and Pt. S.W. 1-5-27-W4

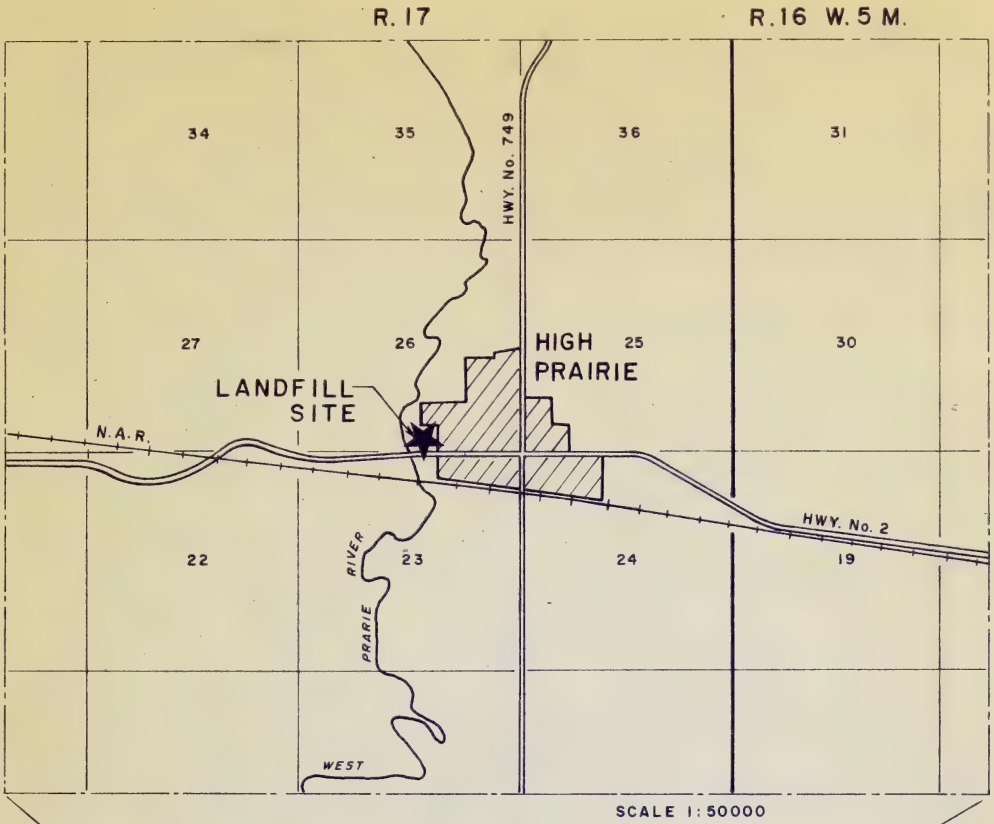
Observation Well #	Type of Observation Well	Date Installed	Observation Well Depth (m)	Height of Pipe Above Ground Surface (m)	Screened Interval (m)	Ground Elevation (m)	Elevation Top of Pipe (m)
3660-T(1)	WTW	84/08/22	22.45	0.64	16.40 - 22.45	1096.39	1097.03
3660-T(2)	WTW	84/08/22	5.23	0.61	1.5 - 5.23	1096.39	1097.00
3664-T(1)	WTW	84/08/23	5.98	0.58	1.5 - 5.98	1096.81	1097.39
3664-T(2)	PIEZ	85/02/20	6.44	0.67	5.48 - 6.44	1096.81	1097.48
3665-T	WTW	84/08/23	5.59	0.21	1.5 - 5.59	1079.76	1079.97
6078-H	WTW	79/09/13	5.61	0.35	0.0 - 5.61	1095.42	1095.77
7456-H(1)	WTW	85/02/18	23.51	0.66	11.31 - 23.51	1097.70	1098.36
7456-H(2)	WTW	85/02/19	7.15	0.61	1.15 - 7.15	1097.70	1098.31
7457-H	WTW	85/02/19	9.45	0.54	3.35 - 9.45	1095.45	1095.99
7458-H	WTW	85/02/21	22.37	0.56	10.17 - 22.37	1096.18	1096.74
7459-H	WTW	85/02/22	25.06	0.64	12.86 - 25.06	1097.14	1097.78
7460-H	WTW	85/02/25	7.53	0.52	1.46 - 7.53	1094.98	1095.50
7461-H	WTW	85/02/25	9.47	0.55	3.37 - 9.47	1096.80	1097.35
7462-H	WTW	85/02/26	7.82	0.63	1.72 - 7.82	1098.59	1099.22

HIGH PRAIRIE RECLAIMED LANDFILL

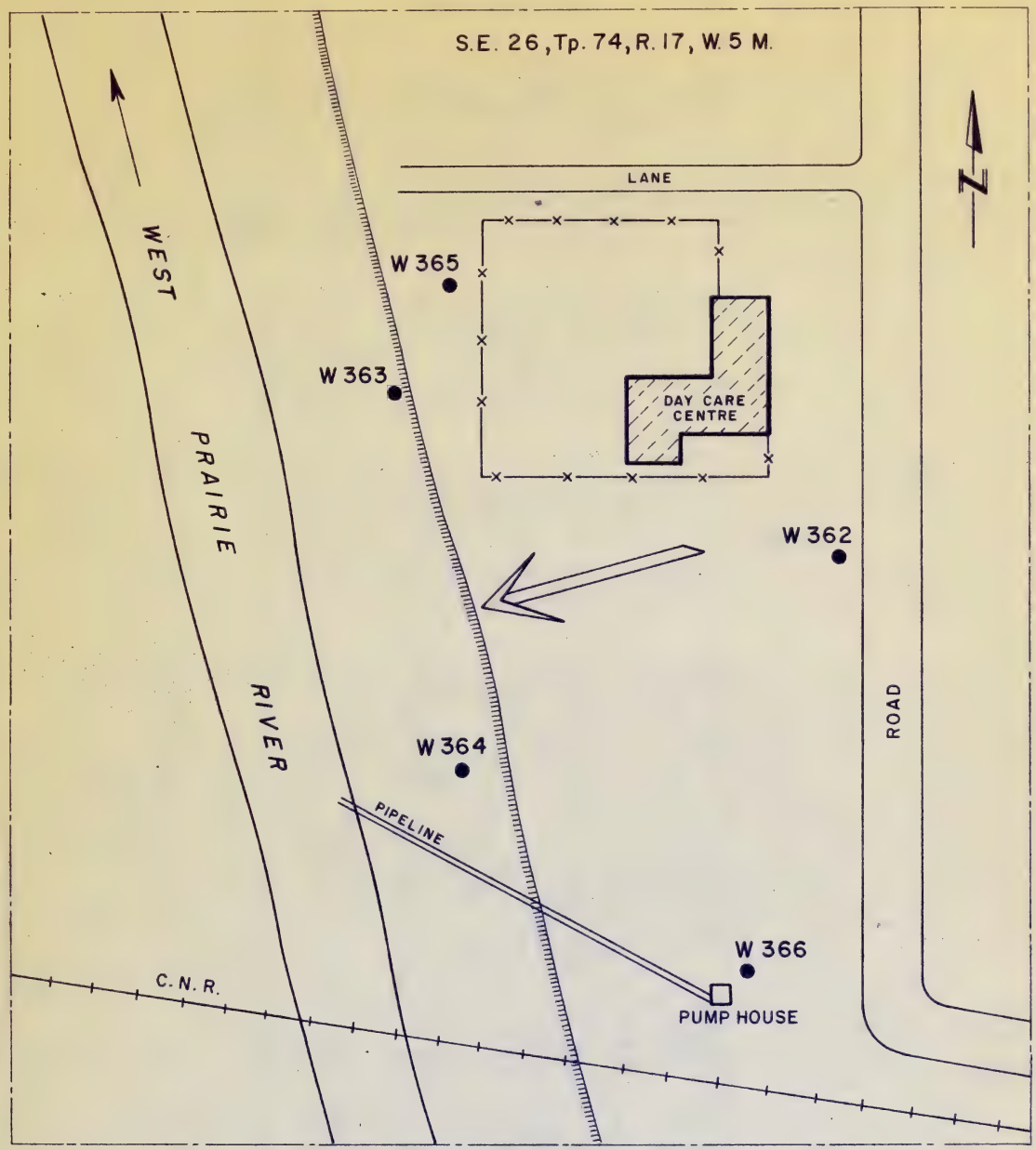
SE 26-74-17-W5

The High Prairie reclaimed landfill is located in the southwest corner of High Prairie (Figure 1). During the Phase III study five water table wells were installed around the landfill to establish shallow groundwater quality. Well locations are shown in Figure 2. The study concluded that groundwater beneath and possibly down-gradient from the landfill has been contaminated; however, the level of contamination, with the exception of groundwater from W364, is low. Groundwater from W364 exhibited abnormally high concentrations of iron and manganese.

The wells were resampled on May 15, 1986 to confirm Phase III monitoring results. In addition, two samples were collected from the West Prairie River for chemical analysis. Analytical results from the latest sampling and from October 9, 1985, contained in Table 1, indicate that shallow groundwater contamination down-gradient from the landfill is insignificant (i.e. does not pose a threat to the environment). Iron and manganese concentrations in groundwater from W364 were significantly lower on the May 15, 1986 analysis than on the October 9, 1985 analysis. The two river water analyses indicate that contaminated groundwater from the landfill has not polluted river water. Based on the findings it is recommended that the site be down graded to Class 3, no further action required.



Alberta ENVIRONMENT EARTH SCIENCES DIVISION		HIGH PRAIRIE LANDFILL STUDY
SUBMITTED W. J. Cerwin DATE Oct. 27/86	DESIGNED W. CEROICI CHECKED W. CEROICI	LOCATION PLAN
APPROVED Don Cragg DATE Oct 27/86	DRAWN H.O. CHECKED	SCALE —— DATE 1986 SEPT.
		SHEET OF FIGURE No. 1



LEGEND:

W 362 ● WATER TABLE WELL

—x—x— FENCE

RIVER BANK

DIRECTION OF GROUNDWATER FLOW

Alberta ENVIRONMENT EARTH SCIENCES DIVISION		HIGH PRAIRIE LANDFILL STUDY
SUBMITTED W. I. Lewis DATE Oct 27/86	DESIGNED W. CEROICI CHECKED W. CEROICI	SITE PLAN (S.E. 26, Tp. 74, R. 17, W. 5 M.)
APPROVED L. Gallagher DATE Oct. 27/86	DRAWN H. O. CHECKED	SCALE 1: 1250 SHEET OF DATE 1986 SEPT. FIGURE No. 2

TABLE 1: WATER ANALYSIS RESULTS

Sample Number	362		363		364		365		366		River Upstream	River Downstream	C.D.W.S.*
Sampling Date	85/10/09	86/05/15	85/10/09	86/05/15	85/10/09	86/05/15	85/10/09	86/05/15	85/10/09	86/05/15	86/05/15	86/05/15	
LAB DATA													
pH	7.93	7.7	8.13	6.68	5.47	6.44	7.62	7.69	7.92	7.9	6.82	6.93	
EC (mS/cm)	1.09	1.07	1.60	1.84	2.23	1.46	1.59	2.36	1.10	1.26	0.17	0.18	
SAR	.08	0.59	0.6	0.69	0.2	0.2	0.7	2.27	0.3	0.38	0.23	0.34	
LAB ANALYSIS (all parameters in mg/L)													
Inorganic													
Ca	147	160	242	281	500	259	198	277	165	196	20	22	NE**
Mg	46.8	41.31	63.6	78.98	57	59.53	60	69.86	41.4	47.39	5.47	5.47	150
$CaCO_3$ (T.Hard)	560	884	870	1025	1485	890	-	980	585	685	73	78	500
Na	43.9	32.2	39.3	50.6	13.9	13.8	41.6	163.3	18.5	23	4.6	6.9	300
K	7.4	2.7	5.08	5.9	3.91	3.1	3.91	9.4	2.35	3.5	1.6	2.0	NE
HCO_3	693.57	775	512	492	15.25	184	781.4	1245	642.94	732	56	. 82	NE
$CaCO_3$ (T.Alk.)	568.5	635	419	403	12.5	151	640.5	1021	527	600	46	67	500
SO_4	76.8	7.2	360	475.5	1416	722.3	98.4	21.6	48	57.6	31.2	21.6	500
Cl	15.95	9.8	114.33	146.2	23.04	20.4	86.85	228.6	40.77	62	3.6	4.4	250
NO_3-N+NO_2-N	0.84	< 0.07	0.35	2.1	< 0.07	< .07	0.14	0.07	0.14	< 0.07	< 0.07	< 0.07	10
NH_4-N	4.41	5.18	0.21	0.49	2.24	1.89	3.9	6.79	3.15	3.64	0.28	0.35	0.5
TDS	910	641	1077	1289	2021	1173	877	1390	632	754	94	103	1000
Organic													
COD	88	99	41	30	34	-	78	92	49	43	75	69	
TOC	-	28	-	14	-	-	-	5	-	27	22	24	
TIC	-	168	-	116	-	-	-	53	-	217	11	14	
Metals													
Fe	25.4	45.2	0.14	0.55	162	34.60	44.2	27.80	15	36.2	0.64	0.45	0.03
Mn	1.87	1.83	1.19	0.73	107	15.60	3.16	4.70	2.12	2.44	0.10	0.07	0.05
Cu	0.01	0.01	0.02	0.01	0.21	0.01	0.01	0.01	0.02	0.01	0.01	0.01	1.0
Zn	0.04	0.03	0.03	0.03	0.08	0.21	0.04	0.02	0.04	0.03	0.02	0.02	5.0
Pb	0.05	0.05	0.05	0.05	0.02	0.04	0.05	0.05	0.01	0.04	0.01	0.01	0.05

* Canadian Drinking Water Standards
** Not Established

MINBURN

SW 14-50-10-W4

The Minburn landfill is located about 0.5 km southeast of Minburn (Figure 1). The Phase III study conducted at the site by Alberta Environment concluded that the landfill has had minimal impact on shallow groundwater quality. The only concern was the anomalously high organic load in groundwater from P409 located down-gradient from the landfill (Figure 2).

Wells 404, 407 and 409 were resampled on April 26, 1986. Analytical data, contained in Table 1 confirm that shallow groundwater contamination is negligible. The total organic carbon (TOC) and chemical oxygen demand (COD) concentrations in groundwater from P409 were low, consistent with groundwater from other wells. The anomalously high TOC and COD levels in groundwater from P409 on September 5, 1985 may have been attributable to sampling and/or analytical error.

The landfill does not meet present landfill siting criteria due to the presence of permeable sand deposits. It is recommended that liquid wastes not be disposed of at the site. Groundwater monitoring activities at the site will be discontinued since minimal groundwater contamination has been detected.

TABLE 1: HANDCAN ANALYTICAL DATA

WELL NUMBER	W404		W407		P409		CDWS*
SAMPLE DATE	85/09/05	86/04/29	85/09/05	86/04/29	85/09/05	86/04/29	
FIELD DATA							
EC (mS/cm)	.45	0.40	1.25	1.5	0.7	0.94	
pH	6.8	7.3	6.6	7.2	6.7	7.4	
LAB DATA							
pH	7.8	7.47	7.8	7.19	7.9	7.46	
EC (mS/cm)	0.44	0.42	1.4	1.78	0.9	0.95	
SAR	0.32	0.32	0.28	0.29	0.3	0.43	
LAB ANALYSIS (all parameters in mg/L)							
Inorganic							
Ca	70	73	208	290	81	142	NE**
Mg	18	16.4	78	133.3	45	47.4	150
$CaCO_3$ (T. Hard)	250	250	845	1150	390	550	500
Na	11.6	11.5	18.5	23	14	23	300
K	1.6	1.9	3	2.7	4.3	5.5	NE
HCO_3	320	307.5	385	446.1	443	536.9	NE
$CaCO_3$ (T. Alk)	263	252	316	366	363	440	500
SO_4	14.4	14.4	504	768.5	105	146.5	500
Cl	1.8	1.77	13.3	20.38	6.2	3.55	250
NO_3-N + NO_2-N	0.08	0.21	1.5	0.91	0.35	<0.07	10
NH_4-N	0.14	<0.07	0.14	0.07	2.1	1.26	.5
TDS	236	271	1021	1431	475	623	1000
Organic							
COD	12	<2	14	10	406	29	
TOC	3.1	4	4.4	9.4	143	6.9	
TIC	67	35.8	78.4	38.4	74.6	85.1	
TC	70	39.8	82.8	47.8	217.6	92.0	
Metals							
Fe	0.02	0.01	0.01	0.01	0.05	0.14	0.3
Mn	0.11	<0.01	0.59	0.01	0.22	0.88	0.05
Cu	<0.01	0.01	0.01	0.01	0.01	0.01	1.0
Zn	0.01	0.03	0.01	0.03	0.02	0.03	5.0
Pb	0.02	0.04	0.04	0.04	0.03	0.04	0.05

* Canadian Drinking Water Standard
** Not Established

RED DEER (SEWAGE TREATMENT PLANT) LANDFILL
NW 34-38-27-W4

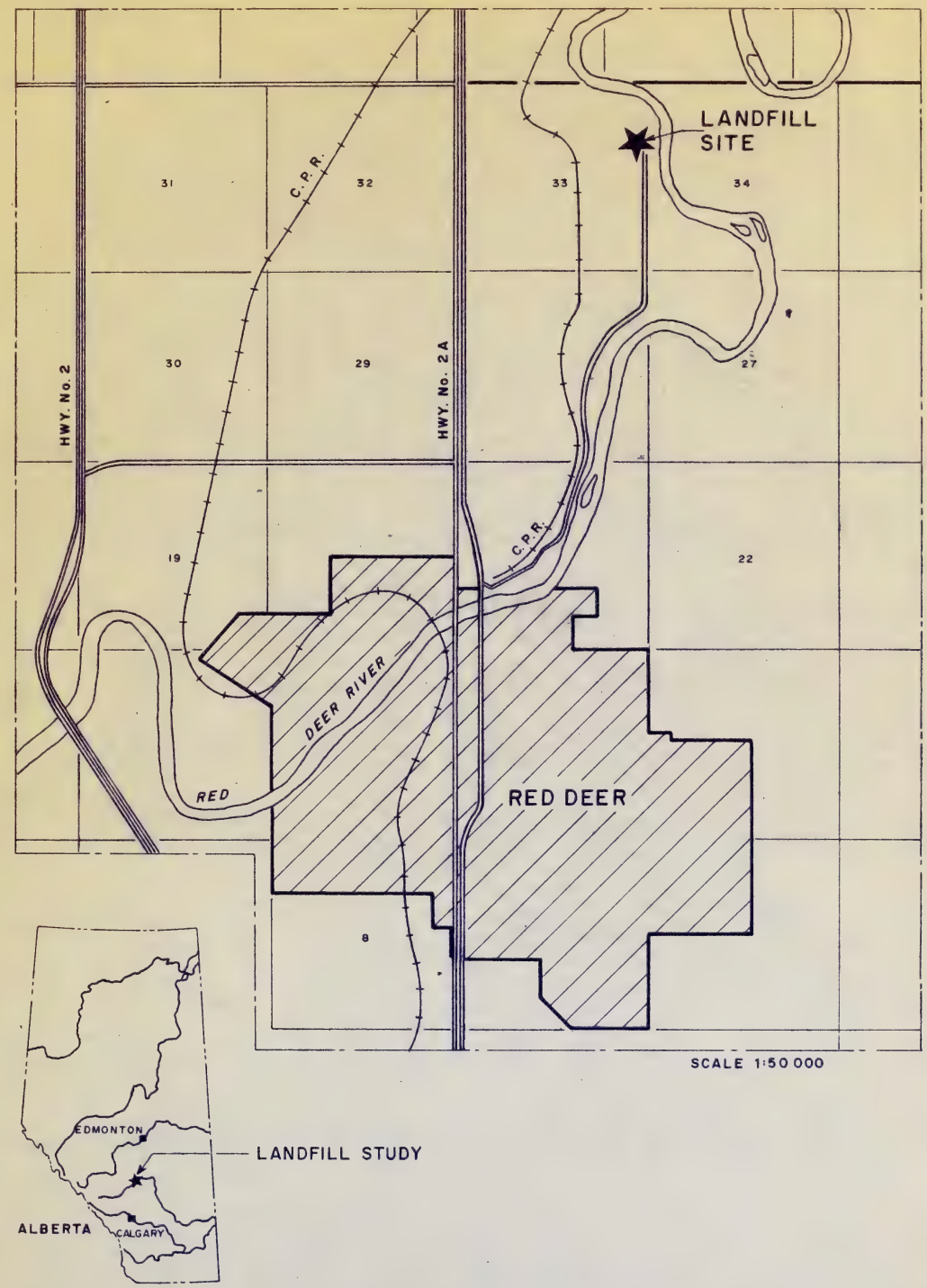
Groundwater contamination around a reclaimed landfill in northeast Red Deer (Figure 1) was studied in the Phase III report. The report concluded that groundwater down-gradient from the landfill is contaminated with inorganic and organic compounds. Contaminated groundwater is seeping into the Red Deer river from at least two locations downgradient from the landfill. The Phase III report recommended that additional river samples be collected for chemical analysis.

In the landfill area, alluvial sand and gravel overlies shale. The low permeability of the shale (based on visual examination and on slow water level recovery in the wells) restricts downward movement of contaminated groundwater. As a result, contaminated groundwater tends to move laterally along the sand and gravel-shale contact. Seepages occur where the contact outcrops on the river bank below the landfill site. The seepage rate is low due to the low horizontal hydraulic gradient.

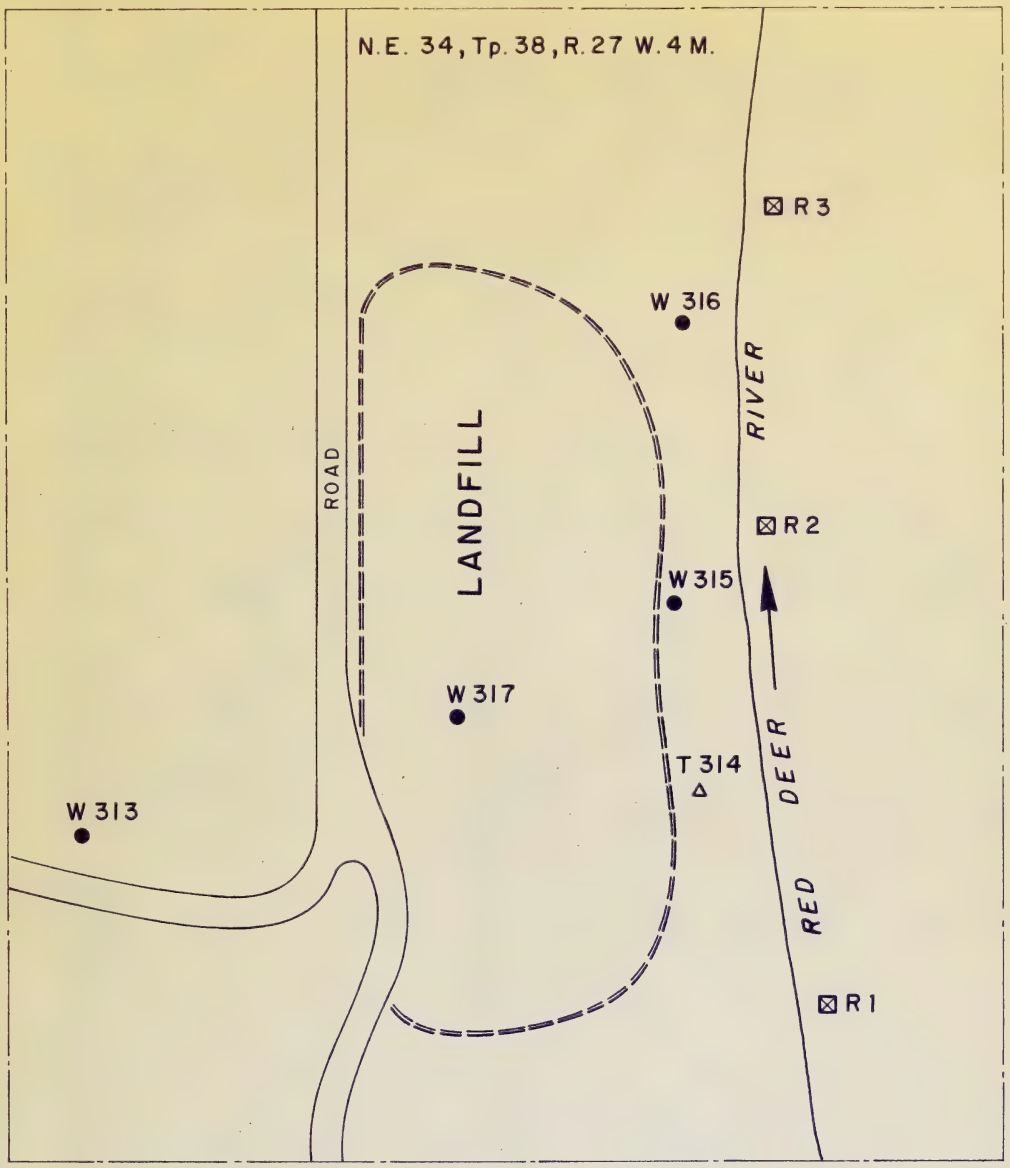
River samples were taken at three locations, one upstream from the disposal site, one from a seepage location and one down stream of the disposal site (Figure 2). All of the samples are chemically similar (Table 1) indicating that the seepage of contaminated groundwater from the landfill has not polluted Red Deer River water. The samples were not subjected to detailed organic analysis because the low chemical oxygen demand (COD) and total organic carbon (TOC) indicate the organic load is low.

Since the contaminated groundwater from the landfill is not affecting river water quality it is recommended that the site be down-graded to Class 3. No remedial action or further monitoring is required.

R. 27 W. 4 M.



Alberta ENVIRONMENT EARTH SCIENCES DIVISION		RED DEER RECLAIMED LANDFILL STUDY	
SUBMITTED W. J. Lyon DATE Oct 27/86	DESIGNED W. CEROICI CHECKED W. CEROICI	LOCATION PLAN	
APPROVED D. McCracken DATE Oct 27/86	DRAWN H.O. CHECKED	SCALE ——	SHEET OF
		DATE 1986 OCT.	FIGURE No. 1



LEGEND:

W 317 ●	WATER TABLE WELL
T 314 △	TEST HOLE
R3 ⊠	RIVER SAMPLING POINT

Alberta ENVIRONMENT EARTH SCIENCES DIVISION		RED DEER RECLAIMED LANDFILL STUDY	
SUBMITTED W. Lui DATE Oct 27/86	DESIGNED W. CEROICI CHECKED W. CEROICI	SITE PLAN (N.E.34, Tp.38, R.27, W.4 M.)	
APPROVED DATE Oct. 27/86	DRAWN H.O. CHECKED	SCALE 1:1250 DATE 1986 OCT.	SHEET OF FIGURE No. 2

TABLE 1: ANALYTICAL RESULTS

May 7, 1986

WELL NUMBER	River 1 Upstream	River 2 At Middle of site	River Downstream	CDWS*
FIELD DATA				
EC (mS/cm)				
pH				
LAB DATA				
pH	8.45	8.38	8.35	
EC (mS/cm)	.32	.31	.31	
SAR	.45	.38	.38	
LAB ANALYSIS (all parameters in mg/L)				
Inorganic				
Ca	47	45	45	NE**
Mg	15.2	15.2	15.2	150
$CaCO_3$ (T. Hard)	5.4	4.5	4.5	500
Na	13.8	11.5	11.5	300
K	1.9	1.9	1.9	NE
HCO_3	203	205	205	NE
$CaCO_3$ (T. Alk.)	175	175	176	500
SO_4	36	26	26	500
Cl	2.66	2.66	1.77	250
NO_3-N + NO_2-N	.07	<.07	<.07	10
NH_4-N	<.07	<.07	<.07	0.5
TDS	222	208	207	1000
Organic				
COD	14	23	19	
TOC	42.5	41.1	62.1	
TIC	.3	.3	.3	
TC	42.8	41.4	62.4	
Metals				
Fe	.10	.10	.13	0.3
Mn	.01	.02	.01	0.05
Cu	.01	.01	.01	1.0
Zn	.05	.05	.03	5.0
Pb	.02	.03	.03	0.05

* Canadian Drinking Water Standards
** Not Established

N.L.C. - B.N.C.
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